THE CLAIMS

What is claimed is:

1. A semiconductor process system adapted for processing of a material therein, said system comprising:

    a sampling region for the material;

    an infrared radiation source constructed and arranged to transmit infrared radiation through the sampling region;

    a thermopile detector constructed and arranged to receive infrared radiation after the transmission thereof through the sampling region and to responsively generate output signals correlative of said material; and

    process control means arranged to receive the output signals of the thermopile detector and to responsively control one or more process conditions in and/or affecting the semiconductor process system,

    wherein said infrared radiation is transmitted along a transmission path that is substantially linear, and wherein said infrared radiation source and said thermopile detector are aligned along the transmission path of said infrared radiation.

2. The semiconductor process system of claim 1, wherein the thermopile detector comprises an infrared radiation band pass filter that selectively transmits at least a portion of the infrared radiation characterized by a predetermined wavelength range, and wherein said predetermined wavelength range encompasses an absorption wavelength that is characteristic to said material.

3. The semiconductor process system of claim 1, wherein said infrared radiation source comprises a parabolic mirror for providing a substantially parallel beam of infrared radiation.

4. The semiconductor process system of claim 3, wherein said thermopile detector comprises a focusing lens for focusing the substantially parallel beam of infrared radiation after the transmission thereof through the sampling region.

5. The semiconductor process system of claim 1, wherein said sampling region is substantially isolated from said infrared radiation source and said thermopile detector.

6. The semiconductor process system of claim 1, wherein said sampling region comprises a part of the flow circuitry through which a process gas is flowed.

7. The semiconductor process system of claim 6, wherein the infrared radiation is transmitted through said sampling region in a direction that is substantially perpendicular to the direction of the process gas flowed therethrough.

8. The semiconductor process system of claim 1, wherein said process control means comprises an integrated circuit board that is arranged in immediate signal receiving relationship with said thermopile detector for minimizing signal loss during signal transmission.

9. The semiconductor process system of claim 8, wherein said integrated circuit board is positioned adjacent to said thermopile detector.

10. The semiconductor process system of claim 6, comprising an abatement unit for abating at least one component of said process gas subsequent to its use in an upstream unit of the system, and wherein said sampling region is constructed and arranged for obtaining a sample of said process gas before its entry into the abatement unit.

11. The semiconductor process system of claim 10, wherein said abatement unit comprises one or more scrubbers selected from the group consisting of dry scrubbers, wet scrubbers, and thermal scrubbers.

12. The semiconductor process system of claim 10, wherein said process gas comprises one or more component selected from the group consisting of tetraethyloxysilane, silane, silicon tetrafluoride, silicon-containing organic compounds, boranes, arsenic hydride, phosphine, hydrogen fluoride, fluorine, tungsten hexafluoride, hydrogen chloride, chlorine, titanium tetrachloride, perfluorocarbons, nitrous oxide, ammonium, hydrogen, oxygen, argon, and helium.

13. The semiconductor process system of claim 10, further comprising one or more temperature sensors, flow sensors, and chemical sensors for measuring the progress gas before its entry into said abatement unit.

14. The semiconductor process system of claim 13, comprising one or more chemical sensors selected from the group consisting of ultraviolet spectrometers, mass spectrometers, and electrochemical sensors.

15. The semiconductor process system of claim 10, wherein the upstream process unit comprises a chemical vapor deposition chamber.

16. The semiconductor process system of claim 10, wherein the upstream process unit comprises a plasma enhanced chemical vapor deposition chamber.

17. The semiconductor process system of claim 10, wherein the process control means controls the abatement unit according to the output signals generated by the thermopile detector.

18. A semiconductor process system adapted for processing of a material therein, said system comprising:

a sampling region for the material;

an infrared radiation source constructed and arranged to transmit infrared radiation through the sampling region;

a thermopile detector constructed and arranged to receive infrared radiation after the transmission thereof through the sampling region and to responsively generate output signals correlative of said material; and

process control means arranged to receive the output signals of the thermopile detector and to responsively control one or more process conditions in and/or affecting the semiconductor process system,

wherein said infrared radiation is transmitted along a transmission path that comprises an inner surface characterized by a roughness in a range of from about 0.012 μm Ra to about 1.80 μm Ra.

19. A semiconductor process system according to claim 18, wherein said inner surface is characterized by a roughness in a range of from about 0.10 μm Ra to about 0.80 μm Ra.

20. A semiconductor process system according to claim 18, wherein said inner surface is characterized by a roughness in a range of from about 0.10 μm Ra to about 0.20 μm Ra.

21. A semiconductor process system according to claim 18, wherein said inner surface is further characterized by a reflectivity in a range of from about 70% to about 99%.

22. A semiconductor process system according to claim 18, wherein said inner surface is further characterized by a reflectivity in a range of from about 92% to about 97%.

23. A semiconductor process system including flow circuitry for processing of a material therein, said system comprising:

a sampling region for the material;

an infrared radiation source constructed and arranged to transmit infrared radiation through the sampling region;

a thermopile detector constructed and arranged to receive infrared radiation after the transmission thereof through the sampling region and to responsively generate output signals correlative of said material; and

process control means arranged to receive the output signals of the thermopile detector and to responsively control one or more process conditions in and/or affecting the semiconductor process system,

wherein said sampling region is isolated from said infrared radiation source and said thermopile detector with interfacial spaces therebetween, and wherein a purge gas is provided at said interfacial spaces for removing particles contained by said material and preventing particle deposition thereat.

24. The semiconductor process system of claim 23, further comprising one or more purge gas sources arranged in fluid communication with said interfacial spaces for flowing the purge gas through said interfacial spaces into the gas sampling region.

25. The semiconductor process system of claim 24, wherein said one or more purge gas sources comprise one or more porous media, through which the purge gas is passed before its entry into the interfacial spaces.

26. The semiconductor process system of claim 24, wherein said sampling region comprises a part of the flow circuitry through which a process gas is flowed, and wherein said process gas contains particles or is susceptible to particle formation.

27. The semiconductor process system of claim 26, wherein said purge gas flows through said interfacial spaces into said sampling region in a direction that is away from the infrared radiation source or the thermopile detector, and is subsequently discharged from said sampling region into the process gas flow circuitry.

28. The semiconductor process system of claim 27, wherein said purge gas enters said interfacial spaces in a direction substantially parallel to that of the process gas flow, and flows through said interfacial spaces into said sampling region in a direction substantially perpendicular to that of the process gas flow.

29. The semiconductor process system of claim 27, wherein said purge gas enters and flows through said interfacial spaces in a direction substantially perpendicular to that of the process gas flow.

30. The semiconductor process system of claim 23, further comprising one or more purge gas sources arranged in fluid communication with said interfacial spaces for providing one or more sheaths of purge gas that surround the sampling region and prevent the particles from entering into the interfacial spaces.

31. The semiconductor process system of claim 30, wherein said sampling region comprises a part of the flow circuitry through which a process gas is flowed, and wherein the purge gas is flowed in a direction that is confluent with the process gas flow and forms an annular purge gas flow that encompasses said process gas flow.

32. A semiconductor process system including flow circuitry for processing of a material therein, said system comprising:

a sampling region for the material;

an infrared radiation source constructed and arranged to transmit infrared radiation through the sampling region;

a thermopile detector constructed and arranged to receive infrared radiation after the transmission thereof through the sampling region and to responsively generate output signals correlative of said material; and

process control means arranged to receive the output signals of the thermopile detector and to responsively control one or more process conditions in and/or affecting the semiconductor process system,

wherein the infrared radiation is transmitted from the infrared radiation source to the thermopile detector along a transmission path, and wherein thermal energy is provided for heating at least a portion of the infrared transmission path.

33. A method of operating a semiconductor process including processing of or with a material, said method comprising transmitting infrared radiation generated by an infrared radiation source through a sampling region containing said material, receiving the transmitted infrared radiation with a thermopile detector, generating an output from said thermopile detector indicative of concentration of a desired component of said material, and controlling one or more conditions in and/or affecting the semiconductor process, in response to said output, wherein said infrared radiation is transmitted along a transmission path that is substantially linear, and wherein said infrared radiation source and said thermopile detector are aligned along the transmission path.

34. A method of operating a semiconductor process including processing of or with a material, said method comprising transmitting infrared radiation generated by an infrared radiation source through a sampling region containing said material, receiving the transmitted infrared radiation with a thermopile detector, generating an output from said thermopile detector indicative of concentration of a desired component of said material, and controlling one or more conditions in and/or affecting the semiconductor process, in response to said output, wherein said infrared radiation is transmitted along a transmission path that comprises an inner surface characterized by a roughness in a range of from about 0.012 μm Ra to about 1.80 μm Ra.

35. A method of operating a semiconductor process including processing of or with a material, said method comprising transmitting infrared radiation generated by an infrared radiation source through a sampling region containing said material, receiving the transmitted infrared radiation with a thermopile detector, generating an output from said thermopile detector indicative of concentration of a desired component of said material, and controlling one or more conditions in and/or affecting the semiconductor process, in response to said output, wherein said sampling region is isolated from said infrared radiation and said thermopile detector with interfacial spaces therebetween, and wherein a purge gas is provided at said interfacial spaces for removing particles contained by said material and preventing particle deposition thereat.

36. A method of operating a semiconductor process including processing of or with a material, said method comprising transmitting infrared radiation generated by an infrared radiation source through a sampling region containing said material, receiving the transmitted infrared radiation with a thermopile detector, generating an output from said thermopile detector indicative of concentration of a desired component of said material, and controlling one or more conditions in and/or affecting the semiconductor process, in

response to said output, wherein the infrared radiation is transmitted from the infrared radiation source to the thermopile detector along a transmission path, and wherein thermal energy is provided for heating at least a portion of the infrared transmission path.